

WHAT WE CLAIM IS

-1. A method of displaying -- on a subpixel addressable screen having pixels comprised of separately-addressable, differently-colored subpixels -- digital content including text and/or images represented by a mark-up language including tags that dictate the format in which such content is to be displayed and tags that identify images to be displayed as part of said content, said method comprising:

- accessing said digital content, including accessing one or more images, from a device in which said content is stored or is generated dynamically;

- performing a down-scaling and subpixel-optimization process in which:

- each of said accessed images is a source image for the process;

- said process produces from each such source image a corresponding scaled-down, subpixel optimized image;

- each such scaled image represents the source image from which it has been produced at a lower pixel resolution than the pixel resolution of said source image;

- each such scaled image also represents said source image in a subpixel-optimized manner by causing the luminosity associated with each subpixel within a given pixel of the scaled image to represent the luminosity of the subpixel's color in a portion of the source image that differs for each subpixel as a function of the subpixel's different position in the given pixel; and

- displaying said accessed digital content on said subpixel-addressable screen in a format determined at least in part by one or more tag in said content, including, as part of said formatted display, displaying said scaled images in a subpixel-optimized manner on said screen.

-2. A method as in Claim 1 wherein:

- said accessed digital content includes one or more strings of displayable text characters; and

- said display of said the digital content also includes drawing a string bitmap on said screen to represent said string, which string bitmap is composed from a succession of

separate font bitmaps each selected to correspond to an individual character in the text of said string.

-3. A method as in Claim 2 wherein one or more of said single line strings are represented by font bitmaps that:

- have a font size of 10 pixels per em or less;
- are anti-aliased font bitmaps that assign a color value to a given screen pixel as a graded function of a coverage value representing the percent of the given pixel that is covered by a character shape being represented by the font bitmap; and
- have the shape and pixel alignment of the character represented by such a font bitmap selected to increase the degree of alignment of edges of the character shape with pixel boundaries of said bitmap.

-4. A method as in claim 3 wherein:

- said font bitmaps are anti-aliased because they are subpixel-optimized images of character-font shape;
- said subpixel-optimized font images are subpixel-optimized in a different manner than the scaled images in that:

- the luminosity assigned to each given subpixel of a pixel in one of said scaled images represents the intensity of the given subpixel's corresponding color in a portion of the source image having a position corresponding to the position of the given subpixel in the scaled image; and

- the luminosity assigned to each given subpixel in one of said font bitmaps is a function of:

- a coverage value representing the percent of the given subpixel's area in the font bitmap that is covered by the character-font shape represented by the bitmap; and

- for at least some subpixels of said font bitmaps, a color balancing distribution between the given subpixel's coverage value and coverage values of other nearby subpixels that reduces perceptible color imbalances that would result from differences between coverage values of

nearby subpixels of different colors in the absence of such color balancing distributions.

-5. A method as in Claim 4 wherein the percent of a given font bitmap subpixel's luminosity values that is distributed to achieve color balance is a function of the percent of the given subpixel's luminosity value that causes color imbalance within pixel of which the given subpixel is part.

-6. A method as in Claim 3 wherein:

- said anti-aliased font bitmaps include small font bitmaps having a small font size of eight pixels per em or less; and

- the shape and pixel alignment of the character represented by such a small font bitmap have been selected to increase the degree of alignment of edges of the character shape with pixel boundaries of said small bitmap.

-7. A method as in Claim 6 wherein the font bitmaps of said small font size represent a majority of characters of the Roman alphabet within an advance width of 4 pixel columns or less.

-8. A method as in Claim 7 wherein the font bitmaps of said small font size represent a majority of lowercase letters with an x-height greater than 4 pixels.

-9. A method as in Claim 1 wherein said accessing of said digital content is performed over an computer network.

-10. A method as in Claim 9 wherein said accessing of said digital content is performed over the Internet.

-11. A method as in Claim 1 wherein said digital content includes web pages.

-12. A method as in Claim 1 wherein:

- said screen is part of a browser computer capable of browsing digital content;

- the browser computer includes browser programming that responds to user input requesting a given portion of digital content by requesting that content from a another entity, either a storage device, another computer, or other programming running on the browser computer;
 - said accessing of said digital content is performed in response to the request from the browser programming; and
 - said display of said accessed digital content, including said scaled images, is performed on the screen of said browser computer.
- 13. A method as in Claim 12 wherein:
- said user request is communicated over a computer network from said browser computer to one or more servers;
 - the digital content is accessed by being read from memory or dynamically generated by one or more of said servers;
 - said down-scaling and subpixel-optimization of said source images is performed by one or more of said servers; and
 - said digital content, including said scaled images, is downloaded over said computer network to said browser, which then performs said display of the digital content.
- 14. A method as in Claim 12 wherein:
- said browser computer communicates said user request over a computer network to a proxy server;
 - said proxy server communicates said user request over a computer network to one or more servers that store or dynamically generate said digital content, including said source images;
 - said one or more servers sends said source image to said proxy server;
 - said scaling down of said source images is performed by said proxy server; and
 - the proxy server downloads the digital content, including said scaled images to said browser, which then perform said display of the digital content.

- 15. A method as in Claim 12 wherein said down-scaling and subpixel-optimization of said source images is performed by said browser computer.
- 16. A method as in Claim 12 further including:
 - allowing a user of the browser computer to select one of a plurality of scale factors; and
 - said down-scaling and subpixel-optimizing produces one or more scaled, subpixel-optimized images that each have a pixel size relative to the respective source image that is selected as a function of said user selected scale factor.
- 17. A method as in Claim 16 wherein:
 - said accessed digital content also includes one or more strings of text characters; and
 - said display of said the digital content also includes drawing a string bitmap on said screen to represent said string, which string bitmap is composed from a succession of separate font bitmaps each selected to correspond to an individual character in the text of said string, and
 - the size of said font bitmaps varies as a function of said user selected scale factor.
- 18. A method as in claim 16 wherein:
 - said other entity from which said browser programming requests said digital content is one or more remote computers that said browser programming communicates said request to over a computer network;
 - said user selected scale factor is also communicated from said browser programming over said computer network to one or more of said remote computers; and
 - said scaling down and subpixel optimizing of said source images is performed on one or more of said remote computers at a scale factor that varies as a function of said user selected scale factor communicated over said network.
- 19. A method of producing a subpixel-optimized display image to represent a higher resolution source image, which display image is suitable for display on a subpixel addressable screen having pixels comprised of separately-addressable, differently-colored subpixels, said method comprising:

-determining the luminosity of each given subpixel in a given pixel of said display image by:

- defining a plurality of coverage lines within a window in said source image having a position relative to the source image corresponding to the given subpixel's position relative to the display image, with the position of different source image windows associated with different subpixels of a given display image pixel differing as a function of the different positions of said subpixels within the given display image pixel;
- determining which source image pixels overlaps each of said coverage lines within the given subpixel's source image window;
- determining what length of each of said coverage lines is overlapped by each such overlapping source image pixel;
- determining the luminosity of the given subpixel as a function of the length of each coverage line overlapped by each such overlapping source image pixel and the respective luminosity, in the given subpixel's color, of each such overlapping source image pixel.

-20. A method as in Claim 19 wherein the coverage lines associated with a given subpixel include at least two coverage lines that run in non-parallel directions on said subpixel's source image window.

-21. A method as in Claim 19 wherein the source image window associated with each given subpixel has a size relative to the source image corresponding to the size of a whole pixel relative to said display image.

-22. A method of producing a subpixel-optimized display image to represent a higher resolution source image, which display image is suitable for display on a subpixel addressable screen having pixels comprised of separately-addressable, differently colored subpixels, said method comprising:

- defining a window in said source image having a position relative to the source image corresponding to the given subpixel's position relative to the display image, with the position of different source image windows associated with different subpixels of a given

display image pixel differing as a function of the different positions of said subpixels within the given display image pixel;

-determining the luminosity of each given subpixel in a pixel of said display image as a function of:

- the whole pixel luminosity of each of one or more source image pixels that overlaps the given subpixel's source image window;
- the percent of the given subpixel's source image window overlapped by each such overlapping source image pixel; and
- a color balancing function that distributes subpixel luminosity values between nearby subpixels in the display image to reduce color imbalance.

-23. A method as in claim 22 wherein the source image is a grayscale image.

-24. A method as in claim 22 wherein the source image is a color image, and the whole pixel luminosity value associated with each source image pixel is a function of the average of the source image pixel's luminosity values over all of the source image pixel's different component colors.

-25. A method as in Claim 22 wherein the percent, if any, of a given subpixel's luminosity value that is distributed by said color balancing varies as a function of the percent of said coverage value that causes color imbalance within the pixel of which the given subpixel is part.

-26. A method as in Claim 22 wherein a source image window has a size relative to the source image corresponding to the size of a subpixel relative to the display image.

-27. A method as in Claim 26 wherein:

- a plurality of coverage lines are defined within the given subpixel's source image window;
- the luminosity of the given subpixel is determined by:
 - determining which source image pixels overlaps each of said coverage lines within the given subpixel's source image window;
 - determining what length of each of said coverage lines is overlapped by each such overlapping source image pixel; and

- determining the luminosity of the given subpixel as a function of the length of each coverage line overlapped by each such overlapping source image pixel and the respective whole pixel luminosity of each such overlapping source image pixel.

-28. A method as in Claim 26 wherein:

- a plurality of coverage lines are defined within the given subpixel's source image window;
- the luminosity of the given subpixel is determined by:
 - determining which source image pixels overlaps the given subpixel's source image window;
 - determining what area of the given subpixel's source image window is overlapped by each such overlapping source image pixel; and
 - determining the luminosity of the given subpixel as a function of the area of the source image window overlapped by each such overlapping source image pixel and the respective whole pixel luminosity of each such overlapping source image pixel.

29. A computer system for displaying -- on a subpixel addressable screen having pixels comprised of separately-addressable, differently-colored subpixels -- digital content including text and/or images represented by a mark-up language including tags that dictate the format in which such content is to be displayed and tags that identify images to be displayed as part of said content, said system comprising:

- one or more processors for executing program instructions stored in computer readable memory; and
- one or more computer readable memories storing program instructions for causing said one or more processors to:
 - access said digital content, including accessing one or more images, from a device in which said content is stored or is generated dynamically;
 - perform a down-scaling and subpixel-optimization process in which:
 - each of said accessed images is a source image for the process;
 - said process produces from each such source image a corresponding scaled-down, subpixel optimized image;

- each such scaled image represents the source image from which it has been produced at a lower pixel resolution than the pixel resolution of said source image;
- each such scaled image also represents said source image in a subpixel-optimized manner by causing the luminosity associated with each subpixel within a given pixel of the scaled image to represent the luminosity of the subpixel's color in a portion of the source image that differs for each subpixel as a function of the subpixel's different position in the given pixel; and
- display said accessed digital content on said subpixel-addressable screen in a format determined at least in part by one or more tag in said content, including, as part of said formatted display, displaying said scaled images in a subpixel-optimized manner on said screen.